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ABSTRACT

The differences between reading and mathematics achievement were studied for 10 high and 10 low socioeconomic status (SES) elementary schools in a midwest urban district. The schools representing the top and bottom quartiles from among 40 schools were classified as high or low SES schools by using a set of highly intercorrelated school level SES indicators. These indicators reflect the out-of-school environment and experiences of students that are outside of school control. The gap of almost one standard deviation in mean reading and mathematics achievement levels between these quartiles remained nearly constant as the students progressed from grade two through grade six, and the achievement gap was consistently a little larger for reading than for mathematics. Associated with the achievement gap was a student behavior gap reflected in attendance and suspension rates. The achievement and behavior gaps were highly correlated. Because of the interrelationships between the SES indicators and the percent of minority students the achievement and behavior gaps can not be attributed to the percent of minority students within the elementary schools. (Contains nine references.) (Author/SLD)

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The Longitudinal Effects of Socioeconomic Status on Elementary School Achievement

April 3, 1996

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The Longitudinal Effects of Socioeconomic Status on Elementary School Achievement

Abstract

The study was concerned with the differences between reading and mathematics achievement for ten high and ten low socioeconomic elementary schools in a midwest urban district. The schools representing the top and bottom quartiles were classified as high or low SES schools by using a set of highly intercorrelated school level SES indicators. The SES indicators reflect the out-of-school environment and experiences of the students which are outside of school control. The gap of almost one standard deviation in mean reading and mathematics achievement levels remained nearly constant as the students progressed from grade two through six. The achievement gap was consistently a little larger for reading than for mathematics. Associated with the achievement gap was a student behavior gap reflected in attendance and suspension rates. The achievement and behavior gaps were highly correlated.

The Longitudinal Effects of Socioeconomic Status on Elementary School Achievement

Previous research has demonstrated that socioeconomic status (SES) has a significant influence on student achievement (Mills, 1983; Reyes & Stanic, 1988). Within the educational literature there is a general sense of what SES is, but it is not well defined. Socioeconomic status is measured by a wide variety of factors including parents' educational level, occupations of the parents, family income, and location of residence (White, 1982). Most of the previous research concerning SES and student achievement consists of cross sectional studies based upon correlational techniques. White (1982) found in a meta analysis that correlational studies based upon aggregate groups of students show higher correlations than studies based upon individual student data. School level studies concerning SES and achievement are often based upon SES indicators reflecting the background characteristics of the aggregate group of students enrolled within the school. These SES indicators reflect the out-of-school environment and experiences of students that are outside of school control (Alspaugh, 1991). The correlational studies do not provide an indication of the magnitude of the achievement differences that can be expected between high and low SES schools. One would anticipate an achievement gap associated with SES that has longitudinal effects which accumulate with time as the students move from grade to grade.

Purpose of the Study

This primary goal was to estimate the size of the achievement gap and its longitudinal effects upon cohort groups of high and low SES students as they progress from grades two through six. A secondary goal was to determine if there is also a gap in student behavior associated with SES.

Source of the Data

The data are from a midwest urban school district with forty elementary schools with a grade span of K through six. Descriptive statistics for the forty elementary schools are presented in Table 1. The reading and mathematics achievement scores are from the Missouri Mastery and Achievement Test (MMAT). The student behavior and SES indicators are all percentages based upon the enrollment counts within the elementary schools. The percent attendance is a positive indicator of behavior, whereas the percent of students suspended is a negative indicator of behavior. The percent of students suspended is based upon the number of students receiving in-school or out-of-school suspensions. It does not reflect students with multiple in-school or out-of-school suspensions. The percent of students on free or reduced lunch is a reflection of the level of family poverty experienced by the students in each elementary school. The percent mobility is the number of pupils that transfer in or out after the beginning of the school year divided by the enrollment. The percent stability is the percent of students that attended the elementary school for the entire school year. The percent of students in two parent households is not limited to genetic parents. The percent minority students is the percent of Afro-Americans, Hispanics, Asians, and Native Americans. Most of the minority students within the schools are Afro-Americans.

TABLE 1
Descriptive Statistics for Forty Elementary Schools Within an Urban School District During the Fifth Grade Year (1992-93)

Measure	Mean	Std. Dev.	Minimum	Maximum
Achievement				
Reading	312.55	28.91	257	363
Mathematics	311.40	31.27	238	372
Behavior				
% Attendance	94.70	0.95	92.4	96.3
% Suspended	5.01	5.48	0.0	26.8
SES				
% F/R Lunch	42.08	27.94	3.2	88.0
% Mobility	36.34	19.03	10.6	108.1
% Stability	85.56	5.62	71.4	95.7
% 2 Parents	64.98	13.23	43.7	90.8
Minority				
% Minority	6.51	6.99	1.1	34.7

Table 2 contains a correlation matrix showing the relationship between the student characteristics within the elementary schools and building level achievement for the fifth grade year. The correlation .93 indicates a very high relationship between reading and mathematics achievement. Both behavior indicators have high correlations to reading and mathematics achievement. Within the set of SES measures the percent of students on free or reduced lunch has the largest negative correlation with student achievement. The correlations between reading achievement and the SES indicators are consistently higher than the correlation for mathematics achievement. The SES indicators represent a highly intercorrelated bundle of student characteristics. A multiple regression analysis of the SES measures with reading achievement yields a multiple correlation of .84. Likewise, the multiple R for mathematics is .79. The coefficients of determination from the regression analysis indicate that 71% of the school-to-school variance in fifth grade reading achievement can be associated with the SES measures. Whereas 62% of the school-to-school variance in fifth grade math

achievement can be associated with the SES variables. The multiple correlations are only slightly higher than the correlations between the percent of students receiving free or reduced lunch and the achievement measures. The overall pattern of correlations in the correlation matrix tends to imply that the primary SES concern is reflected by family poverty.

TABLE 2
Correlation Matrix for Forty Elementary Schools
During the Fifth Grade Year(1992-93)

	Ach	Behavior		Socioeconomic Status				Minority
Measure	Math	Att	Susp	Lun	Mob	Stab	Par	Min
Achievement								
Reading	.93	.71	-.66	-.81	-.73	.76	.70	-.43
Mathematics	1.00	.64	-.65	-.74	-.64	.71	.69	-.30
Behavior								
% Attendance		1.00	-.69	-.82	-.63	.65	.70	-.21
% Suspended			1.00	.68	.54	-.61	-.62	.34
SES								
% F/R Lunch				1.00	.78	-.75	-.87	.46
% Mobility					1.00	-.85	-.78	.65
% Stability						1.00	.69	-.49
% 2 Parents							1.00	-.40
Minority								
% Minority								1.00

For a two tailed test with alpha = .01 the critical value = .418.

Formation of the High and Low SES School Groups

Several research studies have documented the differences in achievement between white and minority students (Anick, Carpenter & Smith, 1981; Burton & Jones, 1982; Dummett, 1984). More recent studies are beginning to show that the lower test scores of minority students may be associated with factors other than their minority status (Alspaugh, 1991; Matthews, 1984). The percent of minority

students was not considered as an SES indicator in the schools because of its unique relationships with the achievement measures, behavior indicators, and SES indicators. Because of the negative correlations of -.43 and -.30 between the percent of minority student and achievement one would anticipate an achievement difference between minority and non-minority students. The reader should note that the correlations between the percent of minority students and achievement are an illusion. The partial correlations between the percent of minority students and achievement with the influence of each of four SES indicators removed are included in Table 3. The partial correlations for achievement in Table 3 are basically random variations from zero, indicating that the percent of minority students by itself is not a factor associated with achievement within the elementary schools. The partial correlations for attendance are all positive and two of them are statistically significant. The partial correlations for suspensions are variations from zero. The partial correlations in Table 3 imply that the percent of minority students in the schools after removing the SES indicators is not a factor in student achievement or behavior. One may conclude that as far as student achievement and behavior are concerned the issue is not race itself, but SES indicators associated with race.

TABLE 3
Partial Correlations Between Percent Minority Students and Achievement Measures With the Influence of Other SES Measures Removed

	Achievement		Behavior	
Measure	Reading	Mathematics	% Attendance	% Suspended
% F/R Lunch	-.11	.07	.33*	.04
% Mobility	.09	.21	.34*	-.02
% Stability	.09	.09	.16	.06
% 2 Parents	.19	-.03	.11	.13

* $p < .05$

Because the percent of students receiving free or reduced lunch is the SES indicator most highly correlated with achievement it was used to identify the ten schools within the highest and lowest SES quartiles. Because of the high correlations among free or reduced lunch, mobility, stability and two parent households the same schools would have been identified by using the other SES measures. The ten schools identified as high and low SES represent the top and bottom twenty five percent of the schools within the district. The second grade students within each of the schools during the 1989-90 school year were considered as a cohort group of students. The cohort groups were followed through grade six in the 1993-94 school year. The concept of cohort groups in the study was somewhat limited by the migration of students in and out of the schools. There was more student migration within the low SES schools than within the high SES schools.

Analysis of Student Achievement Data

For the following analysis the school SES levels and the student grade levels are the independent variables. Achievement as measured by the MMAT represents the dependent variable. The MMAT is administered in the spring of each year. Table 4 shows the average reading achievement levels for the high and low SES schools for the cohort groups for grades two through six. The individual student scores for the State of Missouri were scaled to have a mean of 300 and standard deviation of 60. The district as a whole is above state average. The reading achievement gap between the high and low SES schools is almost one standard deviation. Figure 1 illustrates the pattern of reading achievement scores.

School size and SES effects are confounded within the district. The district means in Table 4 are based upon individual student scores rather than building level averages. The mean spring 1993 enrollment for the high SES schools was 491, whereas the mean enrollment for the low SES schools was 270. Lee and Smith (1993)

found that schools with fewer students per grade tend to have higher achievement. The small enrollments within the low SES school may reduce some of the effects of low SES.

TABLE 4
Mean Reading and Mathematics Achievement by Grade Level for High and Low SES Schools

Grade Level	2	3	4	5	6	
Year	1990	1991	1992	1993	1994	Total
Reading						
High SES	336.2	344.2	343.1	337.7	339.4	340.1
Low SES	282.1	289.8	286.4	280.1	289.0	285.5
Achievement Gap	54.1	54.2	56.7	57.6	50.4	54.6
District Average	314.1	325.3	321.7	319.7	321.7	320.5
Mathematics						
High SES	322.4	337.2	343.2	341.8	341.9	337.3
Low SES	278.0	295.7	294.0	283.7	290.3	288.3
Achievement Gap	44.4	41.5	49.2	58.1	51.6	49.0
District Average	306.2	324.2	325.1	320.0	323.5	319.8

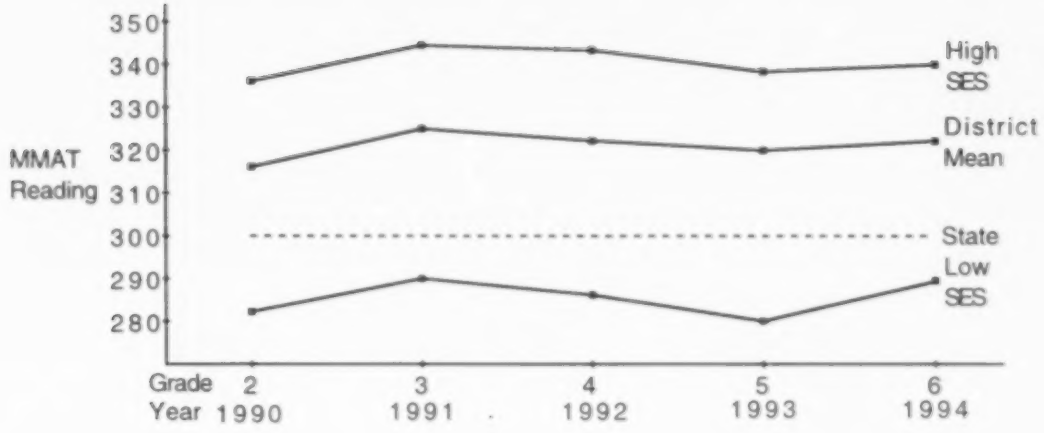

Figure 1: Longitudinal Reading Achievement Scores

Table 5 contains a two way analysis of variance with grade levels as a repeated measure (Ferguson & Takane, 1989). The mean reading achievement gap between high and low SES schools is highly significant. The small F test value for grade levels implies that the reading achievement levels remain stable from grade to grade. The lack of an interaction between the SES levels of the schools and grade levels indicates that the achievement gap does not change significantly with the grade levels.

TABLE 5
Two Way Analysis of Variance With Repeated Measures
for Reading and Mathematics Achievement

Source	SS	DF	MS	F
Reading				
Between Subjects				
Rows (SES Levels)	74,583.61	1	74,583.61	90.75**
S/R	14,794.18	18	821.90	
Within Subjects				
Columns (Grades)	208.31	4	52.08	0.24
RxC (SES x Grades)	160.94	4	40.24	0.18
(SxC)/R	15,819.12	72	219.81	
Total	105,566.16	99		
Mathematics				
Between Subjects				
Rows (SES Levels)	59,878.09	1	59,878.09	76.27**
S/R	14,132.42	18	785.13	
Within Subjects				
Columns (Grades)	4,338.86	4	1084.72	0.99
RxC (SES x Grades)	832.46	4	208.12	0.19
(SxC)/R	78,855.96	72	1095.22	
Total		99		

** $p < .01$

The means for mathematics achievement are also contained in Table 4. A comparison of the achievement scores in Table 4 shows that the achievement gap for mathematics achievement is smaller than the achievement gap for reading. The achievement gap for mathematics is about three quarters of the statewide standard deviation of 60 whereas, the reading achievement gap is almost one standard deviation. The magnitude of the F test values for the high and low SES quartile schools from Table 5 also documents a larger SES achievement gap for reading than for math. The relative size of the

achievement gaps for reading and mathematics is reflected in the sizes of the correlations in Table 2.

The extremely small F test values for the SES x grade level interactions in Table 5 show that the SES achievement gap is persistent across grade levels. Figures 1 and 2 graphically illustrate the consistency of the achievement gaps in reading and mathematics across the grade levels. One might anticipate that the achievement gap would grow as the cohort groups of students progress from grade to grade. The scaling of the test scores becomes a critical issue in the interpretation of the longitudinal effect of SES on the achievement gap. The MMAT scores in the study were scaled around a Missouri State mean of 300 and standard deviation of 60. The lack of a significant interaction implies that the achievement gap relative to the State as a whole remains nearly constant across grade levels. If the achievement scores would have been from a norm reference test scaled in terms of grade level equivalents it is possible that the achievement gap could have increased as the cohort groups of students progressed to higher grade levels.

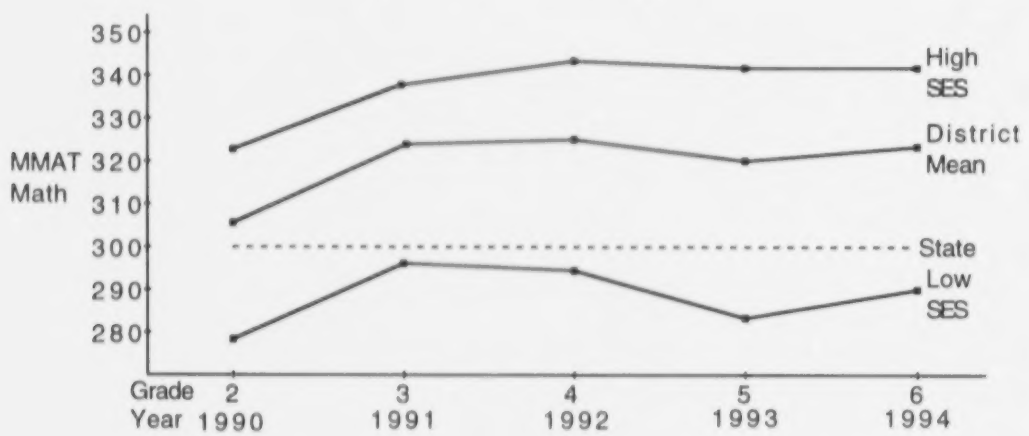

Figure 2: Longitudinal Mathematics Achievement Scores

Analysis of Student Behavior Data

Differences in the student behavior indicators for high and low SES schools are presented in Table 6. The statistics in Table 6 are cross sectional in that they represent all grade levels within the elementary schools during the 1992-93 school year. A t test of the differences between the high and low SES schools for percent attendance and percent suspended are both statistically significantly with an alpha of .01. This implies a difference in student behavior between high and low socioeconomic schools. The correlations in Table 2 between the SES and student behavior indicators are statistically significant. Likewise, the correlations between student behavior and achievement in Table 2 are significant. The data were unavailable to do a longitudinal analysis of the behavior indicators.

TABLE 6
Mean School Behavior Indicators for High and Low SES Schools During Fifth Grade Year (1992-93)

	% Attendance	% Suspended
High SES	95.55	1.20
Low SES	93.72	11.27
Behavior Gap	1.83**	-10.07**
District Average	94.70	5.01

** $p < .01$

Conclusions

The data analysis reveals large gaps in both student achievement and behavior due to factors outside of school control. The gap between the mean achievement levels for the top SES quartile and the bottom SES quartile schools was almost one standard deviation.

The achievement gap for mathematics was a little smaller than the achievement gap for reading. The SES indicators represent the out-of-school environment and experiences of the students. Because the low SES schools are much smaller than the high SES schools there is a confounding of the school size and SES effects within this school district. Lee and Smith (1993), and the author have observed a tendency for smaller schools to have higher achievement. The achievement and behavior gaps are highly related to each other. It is unclear from this data as to whether the achievement gap would grow as the grade levels increase if achievement were measured with a norm reference test scaled in terms of grade level equivalents. Because of the interrelationships between the SES indicators and the percent of minority students the achievement and behavior gaps can not be attributed to the percent of minority students within the elementary schools.

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